FGTL Docket #: 81075405
Title: METHOD AND SYSTEM FOR
CONTROLLING A TRANSFER
CASE CLUTCH TO PROTECT AGAINST HEAT
Applicants: Jiang et al
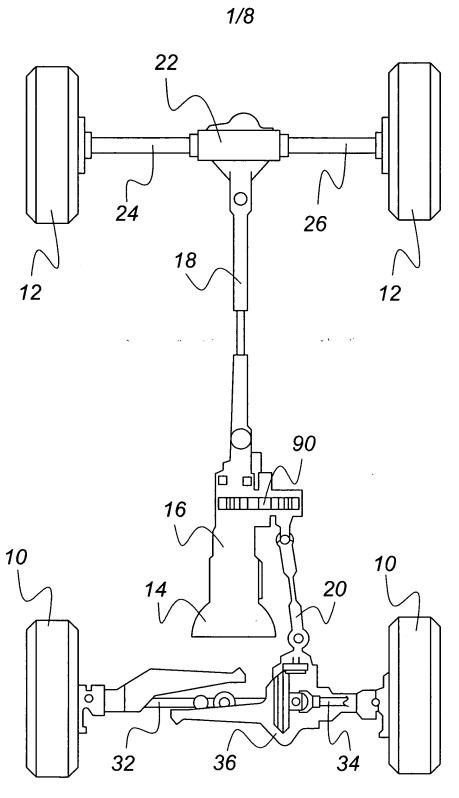Page 1 of 8

1/8

Figure 1

FGTL Docket #: 81075405
Title: METHOD AND SYSTEM FOR
       CONTROLLING A TRANSFER
       CASE CLUTCH TO PROTECT AGAINST HEAT
Applicants: Jiang et al
Page   2 of 8

2/8

Figure 2A

FGTL Docket #: 81075405
Title: METHOD AND SYSTEM FOR
CONTROLLING A TRANSFER
CASE CLUTCH TO PROTECT AGAINST HEAT
Applicants: Jiang et al
Page   3 of 8

3/8

Figure 2B

FGTL Docket #: 81075405
Title: METHOD AND SYSTEM FOR
      CONTROLLING A TRANSFER
      CASE CLUTCH TO PROTECT AGAINST HEAT
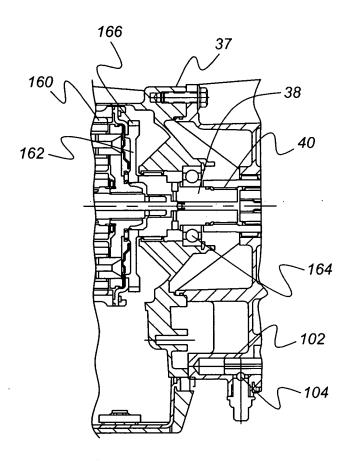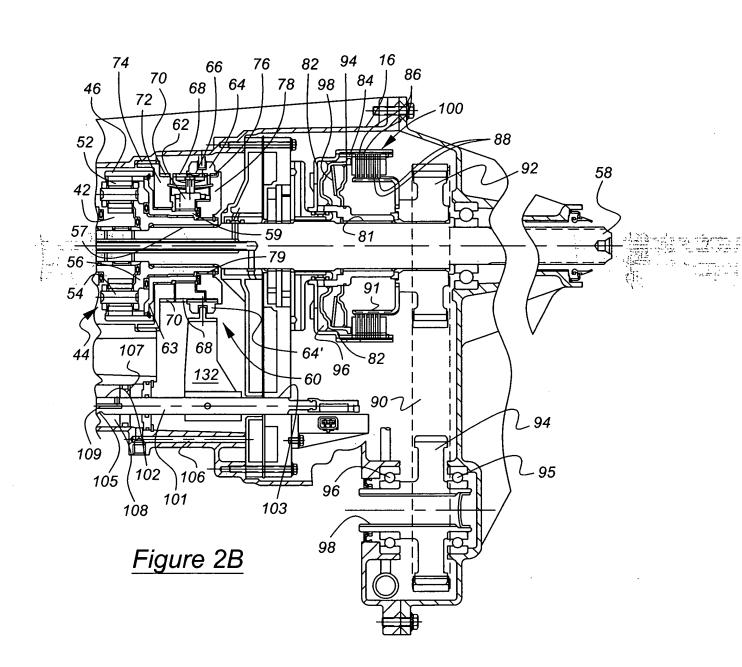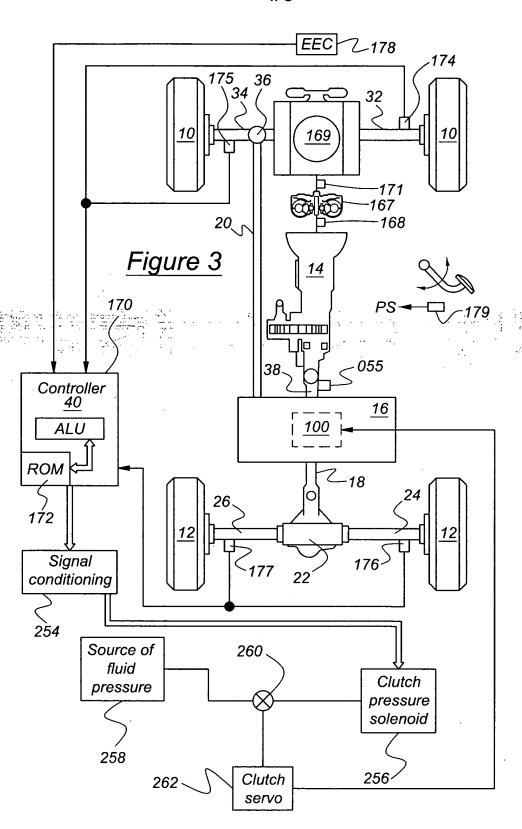Applicants: Jiang et al
Page   4 of 8

4/8

Figure 3

FGTL Docket #: 81075405
Title: METHOD AND SYSTEM FOR
CONTROLLING A TRANSFER
CASE CLUTCH TO PROTECT AGAINST HEAT
Applicants: Jiang et al
Page   5 of 8

5/8

Figure 4A

Process Input ⟩——180

182 — **4 x 4 switch == Auto ?** —No→ Exit (184)

Yes

186 — (Do stroke mode)
Stroke the clutch for
calibrateable period

188 — Delta_wheel_spd
=
rear-front wheel spds

190 — Is
ABS
(delta_wheel_spd.)
>= max_allowed_slip
(fn(veh_spd))? —No→

194 — Is
throttle <=
tp_coast and
dc_cl<=dc_min? —Yes→

Yes

? — Slip_ctr = 0

196 — (Do coast mode)
dc_cmd=
fn(veh_spd)*fn(brk)*fn(slip_ctr)

No

251 — (Do ISWA mode)
ISWA = fn(delta_wheel_spd)
dc_swa = fn(ISWA, veh_spd)
dc_cmd = min(dc_cmd, dc_swa).

252 — (Output pressure)
Convert dc_cmd to clutch pressure
and output pressure to clutch

Heat protection mode —270

(a)   (b)   Exit

FGTL Docket #: 81075405
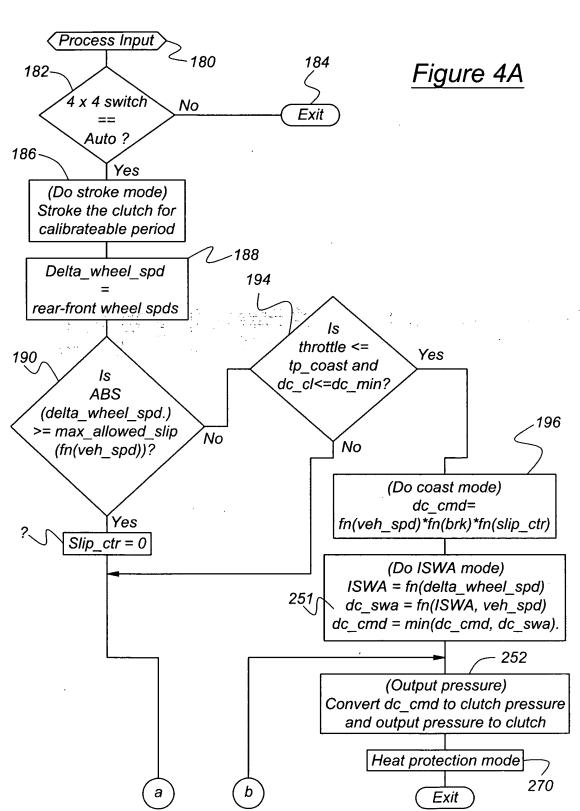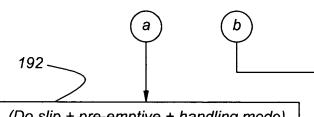Title: METHOD AND SYSTEM FOR
        CONTROLLING A TRANSFER
        CASE CLUTCH TO PROTECT AGAINST HEAT
Applicants: Jiang et al
Page   6 of 8

6/8

Figure 4B

192

(a)   (b)

(Do slip + pre-emptive + handling mode)
traction

Increment slip_ctr counter
Err = delta_wheel_spd-fn(veh_spd).
kp,ki = fn(throttle,veh_spd)n* fn(err).
kc = fn (delta_wheel_spd)

1. TP based pre-emptive duty cycle.
dc_pps = fn(veh_spd, throttle) * fn(slip_ctr).

2. Handling duty cycle.

3. PI close loop duty cycle.
dc_cl = (err * kp + err + ki) * kc

4. TP rate based pre_emptive duty cycle.
dc_pre = fn(throttle rate, veh_spd).
hold dc_pre constant for a while
and then decrement every loop.

5. Total command duty cycle.
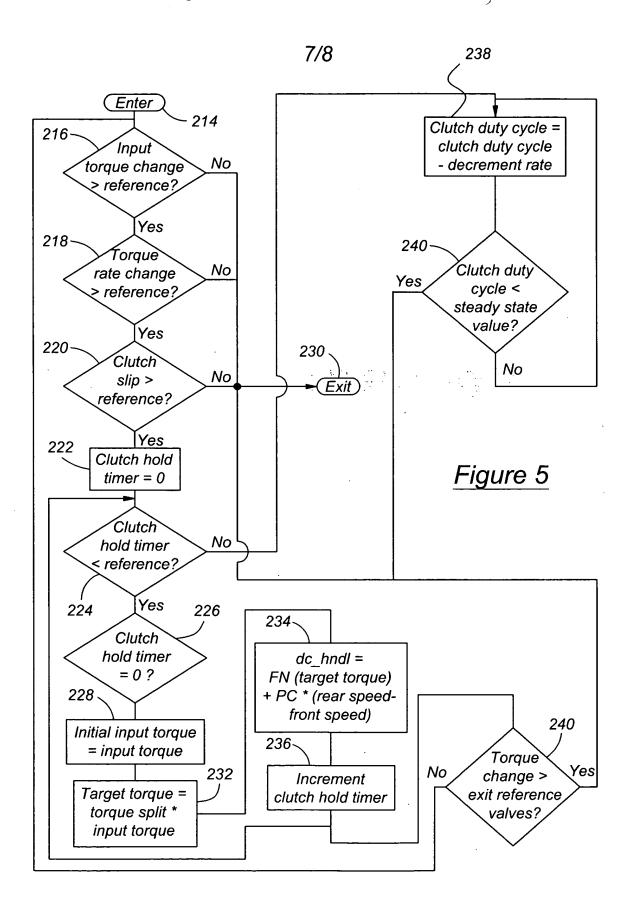dc_cmd = greater of (dc_pps, dc_hndl)
+ dc_cl + dc_pre.

FGTL Docket #: 81075405
Title: METHOD AND SYSTEM FOR
       CONTROLLING A TRANSFER
       CASE CLUTCH TO PROTECT AGAINST HEAT
Applicants: Jiang et al
Page   7 of 8

7/8

Figure 5

FGTL Docket #: 81075405
Title: METHOD AND SYSTEM FOR
CONTROLLING A TRANSFER
CASE CLUTCH TO PROTECT AGAINST HEAT
Applicants: Jiang et al
Page   8 of 8

Figure 6

Enter

272 — Calculate engine torque

274 — Calculate clutch input torque

276 — Determine clutch input power

278 — Calculate clutch output torque

280 — Calculate clutch power output

282 — Calculate heat power dissipated by clutch during current loop

284 — Determine increase in clutch temperature during current loop

286 — Change the clutch temperature

288 — Clutch temperature > preemptive ref. temperature?
No / Yes

290 — Clutch temperature > auto lock temperature?
No / Yes

292 — Command auto lock dc_cmd

294 — Go to preemptive traction mode